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Effects Of The Monoflow Cotton Gin Air System on Ginning Operations, Lint Quality, and Spinning Performance

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Effects of The Monoflow Cotton Gin Air System on Ginning Operations, Lint Quality, and Spinning Performance

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INTRODUCTION

The conventional cotton ginning air system consists of a number of sequential airstreams. Each is used to perform only one or two operations, such as conveying or moisture conditioning, or both. The first airstream is the wagon-unloading stream. This airstream enters the wagon suction telescope pipe and conveys the seed cotton to the first seed cotton separator, where the air is separated from the cotton and is blown back outside by the unloading fan. The final airsteam is the stream that carries the lint to the press condenser, where the air is separated from the lint and exhausted to the outside. The number of additional airstreams used between these two depends upon the amount and configuration of the machinery used in the ginnery. The volume airflow of each stream varies with the use and capacity of the ginning plant, but a range of from 3,500 cubic feet per minute to 20,000 cubic feet per minute includes most ginneries.

The source of air is the atmosphere outside the building; therefore, the temperature and humidity depend upon the weather. Conditioning is generally restricted to heating those airstreams used for seed cotton drying because the cost of conditioning all of the sequential streams is prohibitive. A typical ginnery having one stage of seed cotton drying and two stages of saw-cylinder lint cleaning generally has at least five or six sequential airstreams.

The number of airstreams can be reduced by connecting two or more in series. This procedure requires that the air be cleaned after each cotton-handling operation. The air cleaning can be accomplished by use of inline air filters [2] and small diameter cyclones.[3]

An experimental air system called the "monoflow system," [4] in which the airstreams are connected in series, is under development at the USDA Southwestern Cotton Ginning Research Laboratory at Mesilla Park, N. Mex. This system provides a method of controlling the moisture content of the cotton through the entire ginning process to maintain maximum quality, and also aids in air pollution control by reducing the number of final exhaust airstreams. In the laboratory setup, the number of airsteams has been reduced to two—one to handle the seed cotton and one to handle the lint.

The basis of moisture control in the monoflow system is the hygroscopic property of cotton; that is, cotton's ability to "respond," or come to a moisture equilibrium that depends

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[2] ALBERSON, D. M., and BAKER, R. V. AN INLINE AIR FILTER FOR COLLECTING COTTON GIN CONDENSER AIR POLLUTANTS. U.S. Dept. Agr., Agr. Res. Serv. ARS 42-103, 16 pp. 1964.

[3] UNITED STATES DEPARTMENT OF AGRICULTURE. HANDBOOK FOR COTTON GINNERS. U.S. Dept. Agr., Agr. Handb. 260, 121 pp. 1964.

[4] LEONARD, C. G., and GILLUM, M. N. THE MONOFLOW AIR SYSTEM FOR COTTON GINNING. The Cotton Gin and Oil Mill Press 69 (11): 10, 11, 23, and 24. 1968.

upon the relative humidity of the surrounding air. Through controlled air relative humidity, the monoflow system controls cotton moisture content. The system primarily controls fiber moisture. Although cottonseed is also hygroscopic, cottonseed response time is lengthy when compared with response time of cotton fibers or with normal gin processing times. Therefore, only small changes in seed moisture can be expected during gin processing.

The development of the monoflow system consists of three phases: (1) A feasibility study to determine the practicability of using currently available ginning equipment in the system; (2) a quality study to determine the effects of the system on lint quality and spinning performance; and (3) final development of a complete system using automatic relative humidity controls. This report covers the first and second phases.

OBJECTIVES

The experimental studies for the report had three objectives: (1) To evaluate the effects of the monoflow ginning air system and a conventional ginning air system on ginning operations, cotton quality, and spinning performance; (2) to evaluate the effects on these aspects of cotton processing of the fiber-moisture control provided by the monoflow system during ginning; and (3) to evaluate the effects of the use of card crusher rolls on the spinning performance of cotton ginned with the monoflow ginning air system and with a conventional ginning air system.

EXPERIMENTAL PROCEDURES

Source of Cotton

Acala 1517V, a long staple upland cotton variety, was used in the experiments. The test cotton was irrigation grown on the J. K. Nakayama Farms located a few miles north of Las Cruces, N. Mex., in the Mesilla Valley.

Harvesting Method

The cotton was harvested without harvest-aid chemicals. A two-row John Deere spindle picker was used for harvesting, and water with detergent was used to moisten the picker spindles. The harvest was the first picking and was made on November 3, 1967, after frost. Approximately 38,000 pounds of seed cotton was harvested and hauled to the ginning laboratory on farm trailers.

Ginning Conditions and Treatments

Ginning was started on November 6 and was completed on November 22. During this period the remaining unginned seed cotton was held in storage on the trailers at the laboratory. Safe storage was possible because the average wagon seed cotton moisture content was very low—about 6 percent.

Eight ginning treatments (table 1) were used, two with the conventional air system and six with the monoflow system. In addition, two treatments with the conventional air system and two treatments with the monoflow air system were repeated to obtain cotton for processing treatments. Three replications of each primary and duplicate treatment were made. Thus, a total of 36 ginning lots were used. Each ginning lot yielded one bale of ginned lint. The average gross bale weight was 353 pounds. The ginning treatment order was randomized within each replication.

The ginning machinery setup was kept constant throughout the study (table 2). All lots of cotton were handled in an identical manner. One 80-saw brush doffing gin stand, using 12-inch-diameter saws that had been reduced in width from 90 saws, and one saw-cylinder lint cleaner were used. The seed cotton cleaning machinery sequence was as follows:

- Six-cylinder inclined grid bar cleaner, 50 inches wide, with cylinders operating at 430 r.p.m.
- Stick and green leaf machine, 72 inches wide, with the main (top) cylinder operating at 340 r.p.m.

TABLE 1.—*8 ginning treatments—2 using the conventional air system and 6, the monoflow air system—of machine-picked Acala 1517V, 1967 crop*

System and treatment No.	Seed-cotton-handling subsystem [1]: Air conditions in 1st section	Seed-cotton-handling subsystem [1]: Air conditions in 2d section	Air conditions in lint-handling subsystem	Target lint moisture conditions (wet base) at the lint slide
Conventional:				*Pct.*
1 and 1a [2]	Heated to 200° F.	Ambient	Ambient	[3] NA
2 and 2a [2]	Ambient	do.	do.	[3] NA
Monoflow:				
3	Heated to 200° F.	Relative humidity controlled to 48 pct.	Relative humidity controlled to 48 pct.	6
4	do.	Relative humidity controlled to 65 pct.	Relative humidity controlled to 65 pct.	8
5	Ambient	Relative humidity controlled to 48 pct.	Relative humidity controlled to 48 pct.	6
6	do.	Relative humidity controlled to 65 pct.	Relative humidity controlled to 65 pct.	8
7 and 7a [2]	Relative humidity controlled to 48 pct.	Relative humidity controlled to 48 pct.	Relative humidity controlled to 48 pct.	6
8 and 8a [2]	Relative humidity controlled to 65 pct.	Relative humidity controlled to 65 pct.	Relative humidity controlled to 65 pct.	8

[1] Machinery included in 1st section: horizontal belt cotton moisture conditioner, tower conditioner, separator No. 2, 6-cylinder cleaner No. 1, stick and green leaf machine, and 6-cylinder cleaner No. 2; machinery in 2d section: tower conditioner No. 2, separator No. 3, conveyor-distributor, and extractor-feeder.

[2] Card crusher rolls not used in spinning tests afforded this duplicate treatment.

[3] NA = Not applicable to conventional air system.

- Six-cylinder inclined grid bar cleaner, 50 inches wide, with the cylinders operating at 450 r.p.m.
- An extractor feeder.

The seed cotton was processed at a rate of 1-3/4 bales per hour to prevent a large buildup of overflow. This rate was approximately one-third the capacity of the seed cotton cleaning system.

The variables in ginning were type of air system and air temperature and humidity. The conventional system used six sequential streams of air—four for seed cotton handling and two for lint handling. The monoflow system used two sequential airstreams—one for seed cotton handling and one for lint handling. The airflow paths of the conventional system are shown in figure 1 and those of the monoflow system in figure 2.

Three air-conditioning devices were used in the monoflow system. Two Jackson Model HU-45 Humidaire units were used in the seed cotton subsystem. In the lint-handling subsystem, the condenser air dust tower was converted into an air-cleaning and humidifying unit to condition the gin-room air used to handle the lint. This conversion was made by closing the top of the tower, installing water spray nozzles, and providing a return air duct to the gin room. Exhaust air from the lint cleaner and press condensers was cleaned and moistened by being circulated through spray from the manually controlled nozzles.

When the conventional air system was used (treatments 1 and 2), the only air condition that was controlled was the temperature of the "drying" air in treatment 1. The first Humidaire unit was used to heat the air.

The monoflow system was used for treatments 3 through 8 to obtain two different values (6 and 8 percent) of fiber moisture content at the gin stand, and to maintain these values through lint cleaning to the lint slide. Relative humidities of 48 and 65 percent were chosen for conditioning the fibers to 6-percent and 8-percent moisture content. Three different air conditions were used in the first section of the monoflow system for each of the two fiber moisture values: heated air in treatments 3 and 4, ambient air in treatments 5 and 6, and

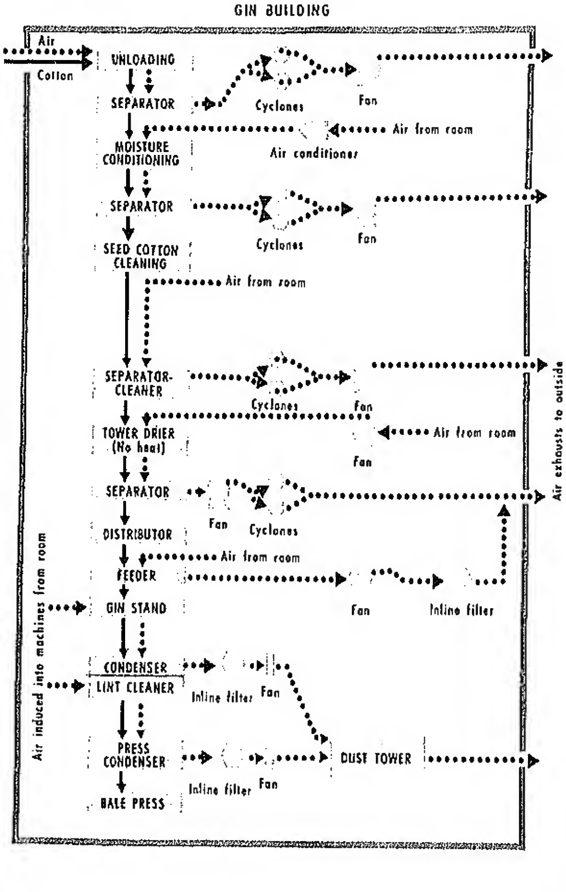

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FIGURE 1.—Cotton and airflow in the conventional air system configuration used in testing cotton moisture control.

moisture-conditioned air in treatments 7 and 8. Target air temperatures and dewpoints at three locations in the system were chosen to obtain the desired moisture treatments. Manual control of the conditioning units was used to hold the air conditions as close to the target values as possible.

The air temperatures and dewpoints were measured at 13 locations (table 3) in the ginning system with thermocouples and Foxboro Dewcels equipped with thermocouples. Relative humidities were obtained by calculations based on dry bulb and dewpoint temperatures. Other measurements made for each test lot included the amount of electric power required to operate the saw gin stand and feeder, the ginning time, the total amount of lint ginned, and the amount of trash removed from the cotton by each cleaner. Samples of seed cotton and lint were taken for moisture and foreign matter content determinations.

Fiber Quality Tests

After bale ties were removed and before processing, samples of cotton were taken at intervals throughout each bale for fiber testing. After mechanical blending, Suter-Webb array, Digital Fibrograph, micronaire, and Pressley strength tests were made on the samples. All fiber tests were made under controlled atmospheric conditions of 70° F. and 65-percent relative humidity.

Processing Tests

Cotton from the experimental ginning treatments was processed through spinning at the U.S. Department of Agriculture Pilot Spinning Laboratory at Clemson, S.C. Each lot was processed identically from opening through

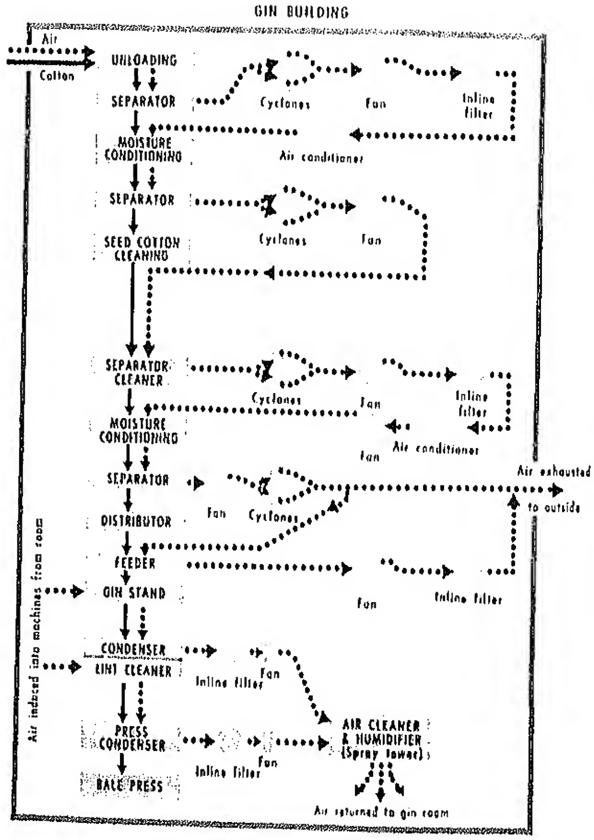

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FIGURE 2.—Cotton and airflow in the monoflow air system configuration used in testing cotton moisture control.

picking. The following organization was used for processing:

Spinning sequence	*Spinning equipment*
Opening	2 blender feeders, 1 lattice opener.
Picker	14-ounce lap, 2-section, 1-process picker.
Carding	6.5 pounds per hour, 50-grain sliver delivered.
Breaker drawing	8 ends up, 50-grain sliver fed, 45-grain sliver delivered.
Lap winding	20 ends up, 45-grain sliver fed, 864-grain lap delivered.
Combing	864-grain lap fed, 53-grain sliver delivered.
Finisher drawing	8 ends up, 53-grain sliver fed, 55-grain sliver delivered.
Roving	1.20 twist multiplier, 55-grain sliver fed, 1.50-hank roving delivered.
Spinning	3.25 twist multiplier, 13,000 spindle speed, 1.50-hank roving fed, 60s combed yarn delivered.

Treatments 1, 2, 7, and 8 were tested with the crusher rolls and duplicate treatments 1a, 2a, 7a, and 8a were tested without the rolls. For treatments 3, 4, 5, and 6, which were ginned with the monoflow air system, all laps were carded with card crusher rolls. A pressure of 297 pounds was applied to the crusher rolls.

The comber was set to remove 14 percent of the comber noils from a special check cotton used for calibration purposes. The check cotton was creeled in the comber before each lot was processed to insure that settings remained the

TABLE 2.—*Ginning-equipment sequences maintained for subsystems of conventional and monoflow gin air systems, and locations used for measuring air temperatures and dewpoints; machine-picked Acala 1517V, 1967 crop*

Type of subsystem and air system, and ginning sequence	Measurement location
SEED-COTTON-HANDLING SUBSYSTEM	
Conventional air system:	
Wagon suction telescope	Above wagon near suction telescope.
Separator No. 1 (unloading)	In separator No. 1.
Feed control	....
Conventional air system and 1st section of monoflow air system:	
Horizontal belt moisture conditioner	On entering conditioner.[1]
Tower moisture conditioner No. 1	....
Separator No. 2	In separator No. 2.
6-cylinder cleaner No. 1 (gravity feed)	....
Stick and green leaf machine	....
Air pickup	At air pick-up.
6-cylinder cleaner No. 2 (blow-in feed)	At cleaner air exhaust.
Conventional air system and 2d section of monoflow air system:	
Tower moisture conditioner No. 2	On entering conditioner.[1]
Separator No. 3	In separator No. 3.
Conveyor distributor	....
Extractor-feeder	On entering feeder.
LINT-HANDLING SUBSYSTEM [2]	
Conventional and monoflow air systems:	
80-saw brush doffing gin	Under gin stand.[1]
Lint cleaner condenser	At condenser exhaust.
Saw-cylinder lint cleaner	Near lint cleaner.
Press lint condenser	....
Lint slide	Near lint slide.
Flat bale press	....

[1] Measurements from these locations were used as guides for manually adjusting system air conditioners so that treatment conditions could be obtained.

[2] Air-conditioned gin room served as source of lint-handling airstream.

TABLE 3.—*Air temperatures and relative humidities measured at 13 locations during ginning treatments with conventional and monoflow gin air systems; machine-picked Acala 1517V, 1967 crop*

Measurement location, air temperature, and relative humidity	Conventional air system treatment [1]—				Monoflow air system treatment [1]—							
	No. 1	No. 1a	No. 2	No. 2a	No. 3	No. 4	No. 5	No. 6	No. 7	No. 7a	No. 8	No. 8a
Above wagon near suction telescope:												
Air temperature—° F.	71	68	68	64	78	77	68	67	68	72	71	65
Relative humidity—pct.	30	30	32	43	25	27	33	44	33	27	32	35
In separator No. 1:												
Air temperature—° F.	79	78	77	73	83	83	77	73	75	76	77	75
Relative humidity—pct.	22	20	23	30	21	22	23	33	25	24	28	25
Entering horizontal belt conditioner [2]:												
Air temperature—° F.	201	201	76	70	203	202	84	81	116	111	117	113
Relative humidity—pct.	([3])	([3])	24	33	([3])	([3])	19	25	53	67	76	79
In separator No. 2:												
Air temperature—° F.	142	140	87	80	143	139	88	86	105	105	110	106
Relative humidity—pct.	([3])	([3])	18	23	([3])	([3])	16	20	48	51	59	61
At air pickup below stick machine:												
Air temperature—° F.	77	74	71	66	142	140	98	96	112	112	116	112
Relative humidity—pct.	23	23	26	36	([3])	([3])	12	16	42	43	52	55
At 6-cylinder cleaner No. 2 exhaust:												
Air temperature—° F.	76	74	74	68	118	115	89	88	97	98	100	97
Relative humidity—pct.	22	23	25	33	15	18	26	30	49	51	62	65
Entering tower conditioner No. 2 [2]:												
Air temperature—° F.	81	79	81	77	123	128	131	121	121	116	119	119
Relative humidity—pct.	20	21	21	27	58	62	49	60	49	55	69	68
In separator No. 3:												
Air temperature—° F.	80	79	80	75	115	119	116	112	109	107	111	110
Relative humidity—pct.	22	26	26	32	60	69	56	64	58	65	69	75
Entering extractor-feeder:												
Air temperature—° F.	90	89	90	86	113	114	112	109	108	108	109	108
Relative humidity—pct.	15	15	16	20	64	77	66	70	60	59	75	74
Under gin stand [2]:												
Air temperature—° F.	72	71	73	67	81	79	76	76	76	78	77	75
Relative humidity—pct.	25	22	24	35	51	60	52	60	51	51	64	62
At lint cleaner condenser exhaust:												
Air temperature—° F.	76	75	75	72	86	85	81	82	81	83	82	80
Relative humidity—pct.	24	23	25	33	48	58	50	58	51	50	62	62

Near lint cleaner:												
Air temperature—° F.	69	69	68	65	77	76	73	73	72	75	74	73
Relative humidity—pct.	27	28	28	35	49	61	48	58	51	49	64	61
Near lint slide:												
Air temperature—° F.	75	73	75	72	75	75	73	72	73	73	73	72
Relative humidity—pct.	28	30	29	34	57	65	52	61	56	56	69	59

[1] Data represents averages of 3 replications.
[2] Measurements from these locations were used as guides for manually adjusting the system air conditioners to obtain treatment conditions.
[3] Dewpoint measurement was not reliable for calculating relative humidity below 11 percent.

same and that 14 percent of the noils were being removed from the check. All lots were combed with the same settings and timing.

Roving was creeled singly into four 252-spindle spinning frames equipped with Duo-Roth drafting systems. New travelers were used for each spinning doff, and frames were run for 30 minutes to break in travelers and to obtain yarn for sizing. Draft gears were changed, if necessary, to obtain the specified yarn size. End breakage was recorded at 15-minute intervals during the spinning of a full doff of yarn.

The card room and spinning room were kept at a temperature of 80° F. and 50-percent relative humidity throughout the tests.

RESULTS

Effects of Treatments During Ginning

Statistical analyses of average moisture regain of seed cotton, ginned lint, cottonseed, and foreign matter; average amount of dry foreign matter removed per bale; average cleaning efficiency; and the average number of kilowatts required to operate the test gin stands and feeders are presented in tables 4 through 8.

The incoming air temperature and relative humidity for all ginning treatments averaged 70° F. and 33 percent. The temperature ranged from 64° to 77° F., and the relative humidity ranged from 25 to 44 percent. Between the wagon suction telescope and the unloading separator, the average temperature increase was 7 degrees, with an attendant decrease in relative humidity. The average wagon seed cotton moisture content was 5.9 percent. Although this was close to the equilibrium moisture for seed cotton at 33-percent relative humidity [5], no correlation was found between wagon seed cotton moisture and the relative humidity of either the air near the wagon telescope or of the unloading air measure at the exhaust of the unloading separator.

With the conventional air system, which used ambient air (table 1, treatment 2), the ginned lint averaged 4.3-percent moisture content when measured at the lint cleaner condenser outlet. With air heated to 200° F. at the inlet to the first stage of seed cotton moisture conditioning, the lint moisture was reduced to 3.1 percent. Lint moisture levels did not change between the lint cleaner and the lint slide to the press box.

Treatments 3, 5, and 7, ginned with the monoflow system, were designed to bring the fiber moisture content to 6 percent at the time of ginning. The average relative humidities in the second section of the monoflow system were 61, 57, and 58 percent for treatments 3, 5, and 7, respectively. The average lint moisture content, measured a few feet behind the gin stand at the lint cleaner condenser outlet, was 5.4, 5.9, and 6.1 percent for treatments 3, 5, and 7, respectively. The relative humidity of the lint-handling air for the three treatments averaged 51 percent and maintained the lint moisture at a nearly constant level through lint cleaning to the lint slide.

Treatments 4, 6, and 8 were designed to bring the fiber moisture content to 8 percent. The relative humidity in the second seed cotton section of the monoflow system averaged 69, 65, and 72 percent, giving lint moisture levels of 6.4, 6.6, and 7.6 percent for treatments 4, 6, and 8, respectively. The lint handling air averaged 62-percent relative humidity with little change in lint moisture between the entrance to the lint cleaner and the lint slide. The target moisture level was not reached in these three treatments, an indication that higher relative humidities were needed, particularly when the seed cotton was dried in the first section of the system.

Cotton and trash moisture values both correlated well with the air relative humidities (table 13, p. 22). The highest correlation coefficient, 0.95, was between the moisture levels of samples taken at the lint cleaner condenser outlet and the relative humidity of the lint cleaner condenser exhaust air.

[5] See footnotes 3, p. 1.

TABLE 4.—*Effects of ginning treatments on oven moisture regain [1] in seed cotton, ginned lint, and cottonseed; machine-picked Acala 1517V, 1967 crop*

Type of ginning air system, treatment No.,[2] and statistical test	Moisture regain[3] in seed cotton sampled			Moisture regain[3] in ginned lint sampled		Moisture regain[3] in cottonseed sampled at gin stand
	At wagon	At 6-cylinder cleaner No. 1	At feeder apron	On entering lint cleaner	At lint slide	
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Conventional:						
1	6.0	5.1a	5.0a	3.18a	3.20a	6.3a
1a	6.4	5.3a	5.4a	3.29a	3.32a	6.6ab
2	6.0	5.7a	5.6ab	4.16 b	4.17 b	6.5ab
2a	6.4	6.0ab	6.0 bc	4.85 c	4.88 c	6.8abc
Monoflow:						
3	6.0	5.1a	6.4 cd	5.68 d	5.79 d	6.3a
4	6.8	5.8ab	7.4 ef	6.86 fg	6.92 ef	7.2 bc
5	5.9	5.7a	6.7 de	6.33 e	6.34 e	6.4a
6	6.0	5.8ab	7.2 ef	7.09 g	7.22 f	6.6ab
7	6.2	6.7 bc	6.9 def	6.44 ef	6.56 e	6.9abc
7a	6.7	7.1 c	7.4 f	6.56 ef	6.64 e	7.2 bc
8	6.4	7.5 c	8.2 g	8.10 h	8.02 g	7.4 c
8a	6.4	6.9 c	8.1 g	8.33 h	8.20 g	7.0abc
	Measure of significance[4]					
Statistical significance as determined by analysis of variance:						
Test form 1:[5]						
Treatments	NS	**	**	**	**	*
Replications	**	**	**	**	**	**
Test form 2:[5]						
Ginning air system	NS	**	**	**	**	NS
Conventional system air conditions	NS	NS	NS	**	**	NS
Monoflow (1st section) air conditions	NS	**	*	**	**	NS
Target lint moisture levels	NS	*	**	**	**	*
Monoflow (1st section) × lint moisture levels	NS	NS	NS	NS	NS	NS

[1] Moisture regain can be converted to moisture contents (wet base) by the formula: Moisture content, percent = [(100) × (moisture regain, pct.)]/[(100) + (moisture regain, pct.)].

[2] See table 1 for description of treatments. Each data represents an average of 3 replicate ginning treatments.

[3] Averages followed by the same letter are not significantly different at the 95-percent level as determined by Duncan's Multiple Range Test. Comparison is made across all 12 treatments.

[4] NS = not significant at the 95-percent level; * = significant at the 95-percent level; ** = significant at the 99-percent level.

[5] For description of statistical test forms, see table 14.

TABLE 5.—*Effects of ginning treatments on oven moisture regain [1] of foreign matter removed by selected ginning equipment; machine-picked Acala 1517V, 1967 crop*

Type of ginning air system, treatment No.,[2] and statistical test	Moisture regain in foreign matter sampled at—						
	Separator No. 1 (unloading)	Separator No. 2 [3]	6-cylinder cleaner No. 1 [3]	Stick and green leaf machine [3]	6-cylinder cleaner No. 2 [3]	Feeder [3]	Saw-cylinder lint cleaner [3]
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Conventional:							
1	6.3	4.3a	6.4a	7.7a	6.7a	7.7a	7.0a
1a	7.1	4.6ab	7.0abc	8.2a	7.2abc	8.5ab	7.9ab
2	6.0	4.5a	7.8abcd	9.2ab	7.1ab	9.1ab	7.4a
2a	7.2	4.9ab	9.0 de	9.3ab	8.5abcd	9.5abc	8.6abc
Monoflow:							
3	6.1	4.5a	6.2a	7.1a	6.8a	9.5abc	9.6 cde
4	6.4	4.3a	6.8ab	7.8a	7.8abcd	11.8 d	9.6 cde
5	6.9	4.7ab	8.6 cde	9.3ab	9.0 cd	12.1 d	9.3 bcd
6	6.3	5.0ab	8.2 bcd	9.4ab	11.1 e	12.2 d	10.1 cde
7	6.7	6.1abc	10.0 ef	11.9 c	9.6 de	11.3 cd	9.2 bc
7a	6.9	6.4 bc	10.6 fg	11.2 bc	8.8 bcd	10.4 bcd	9.1 bc
8	6.5	8.2 d	11.7 g	12.6 c	11.3 e	14.2 e	11.2 e
8a	6.9	7.2 cd	12.0 g	12.1 c	11.0 e	14.2 e	10.9 de
	Measure of significance [4]						
Statistical significance as determined by analysis of variance:							
Test form 1:[5]							
Treatments	NS	**	**	**	**	**	**
Replications	**	NS	*	*	**	NS	*
Test form 2:[5]							
Ginning air system	NS	*	**	NS	**	**	**
Conventional system air conditions	NS	NS	*	NS	NS	NS	NS
Monoflow (1st section) air conditions	NS	**	**	**	**	*	NS
Target lint moistures	NS	NS	NS	NS	**	**	NS
Monoflow (1st section) × lint moistures	NS	NS	NS	NS	NS	NS	NS

[1] Moisture regain can be converted to moisture contents (wet base) by the formula: Moisture content, pct. = [(100) × (moisture regain, pct.)] /[(100) + (moisture regain, pct.)].

[2] See table 1 for description of treatments. Each data represents an average of 3 replicate ginning treatments.

[3] Averages followed by the same letter are not significantly different at the 95-percent level as determined by Duncan's Multiple Range Test. Comparison is made across all 12 treatments.

[4] NS = not significant at the 95-percent level; * = significant at the 95-percent level; ** = significant at the 99-percent level.

[5] For description of statistical test forms, see table 14.

TABLE 6.—*Effects of ginning treatments on amount of dry foreign matter[1] removed per bale by selected ginning equipment; machine-picked Acala 1517V, 1967 crop*

Type of ginning air system, treatment No.,[2] and statistical test	Amount of dry foreign matter removed at—						
	Separator No. 1 (unloading)	Separator No. 2	6-cylinder cleaner No. 1	Stick and green leaf machine	6-cylinder cleaner No. 2[3]	Feeder	Saw-cylinder lint cleaner
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Conventional:							
1	11.5	0.9	36.4	11.3	17.1a	17.6	9.4
1a	9.8	.9	36.3	9.4	16.4a	15.5	9.9
2	13.8	1.1	37.9	12.3	15.3ab	9.8	10.2
2a	12.2	1.5	36.6	11.8	15.1abc	10.5	8.2
Monoflow:							
3	12.0	1.0	36.9	10.1	13.9abc	13.6	10.1
4	12.8	1.1	41.2	12.3	15.4ab	14.0	12.4
5	11.0	1.2	33.7	10.9	11.9 bc	13.0	10.8
6	12.6	1.1	38.9	11.0	12.6 bc	12.4	10.8
7	13.1	1.7	33.4	10.6	12.1 bc	12.7	12.4
7a	11.4	1.1	34.4	11.0	12.6 bc	15.0	13.3
8	12.5	.8	36.6	11.2	12.5 bc	14.2	14.0
8a	10.7	.8	32.3	8.5	11.6 c	12.6	12.8
	Measure of significance[4]						
Statistical significance as determined by analysis of variance:							
Test form 1:[5]							
Treatments	NS	NS	NS	NS	**	NS	NS
Replications	**	**	NS	*	NS	NS	*
Test form 2:[5]							
Ginning air system	NS	NS	NS	NS	**	NS	*
Conventional system air conditions	NS	NS	NS	NS	NS	**	NS
Monoflow (1st section) air conditions	NS	NS	NS	NS	*	NS	*
Target lint moistures	NS	NS	NS	NS	NS	NS	NS
Monoflow (1st section) × lint moistures	NS	NS	NS	NS	NS	NS	NS

[1] Actual foreign matter weights corrected for moisture content and calculated for 478 pounds of clean lint at 6-percent moisture contents.

[2] See table 1 for description of treatments. Each data represents an average of 3 replicate ginning treatments.

[3] Averages followed by the same letter are not significantly different at the 95-percent level as determined by Duncan's Multiple Range Test. Comparison is made across all 12 treatments.

[4] NS = not significant at the 95-percent level; * = significant at the 95-percent level; ** = significant at the 99-percent level.

[5] For description of statistical test forms, see table 14.

TABLE 7.—*Effects of ginning treatments on cleaning efficiency of selected seed cotton equipment, the seed cotton handling subsystem, and the saw-cylinder lint cleaner; machine-picked Acala 1517V, 1967 crop*

Type of ginning air system, treatment No.,[1] and statistical test	Cleaning efficiency of—							
	Separator No. 1 (unloading)	Separator No. 2	6-cylinder cleaner No. 1[2]	Stick and green leaf machine	6-cylinder cleaner No. 2[2]	Feeder[2]	Seed cotton subsystem[2,3]	Lint cleaner
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Conventional:								
1	9.1	0.8	31.7ab	14.4	25.6a	35.3a	75.2a	39.8
1a	7.9	.8	31.9ab	12.1	24.1a	29.9ab	71.6ab	37.5
2	10.6	1.0	33.5a	16.4	24.4a	20.8 c	71.1ab	35.6
2a	9.6	1.4	32.8a	16.1	23.9a	22.4 c	70.7ab	27.7
Monoflow:								
3	9.4	.9	32.8a	13.4	21.3 b	27.1 bc	70.6ab	35.3
4	9.2	.9	32.7a	14.5	21.0 b	24.9 bc	69.8abc	37.4
5	9.1	1.1	31.0abc	14.6	18.7 cd	25.6 bc	68.4 bc	36.6
6	9.5	.9	33.4a	14.0	19.0 bc	23.5 bc	68.6 bc	34.1
7	10.6	1.6	29.8 bcd	13.7	18.0 cde	23.0 bc	66.8 bc	36.7
7a	8.6	.9	28.4 d	12.8	16.6 de	23.6 bc	63.7 c	33.9
8	9.1	.6	29.0 cd	12.6	16.0 e	21.9 c	64.3 c	34.1
8a	8.7	.7	28.6 cd	10.6	15.9 e	20.6 c	67.2 bc	33.1
	Measure of significance[4]							
Statistical significance as determined by analysis of variance:								
Test form 1:[5]								
Treatments	NS	NS	**	NS	**	**	*	NS
Replications	**	**	**	**	**	NS	**	NS
Test form 2:[5]								
Ginning air system	NS	NS	*	NS	**	*	**	NS
Conventional system air conditions	NS	NS	*	NS	NS	**	*	*
Monoflow (1st section) air conditions	NS	NS	**	NS	**	NS	**	NS
Target lint moistures	NS	NS	NS	NS	NS	NS	NS	NS
Monoflow (1st section) × lint moistures	NS	NS	*	NS	NS	NS	NS	NS

[1] See table 1 for description of treatments. Each data represents an average of 3 replicate ginning treatments.

[2] Averages followed by the same letter are not significantly different at the 95-percent level as determined by Duncan's Multiple Range Test. Comparison is made across all 12 treatments.

[3] Calculated using weights of trash collected from all machines in the seed-cotton subsystem.

[4] NS = not significant at the 95-percent level; * = significant at the 95-percent level; ** = significant at the 99-percent level.

[5] For description of statistical test forms, see table 14.

TABLE 8.—*Effects of ginning treatments on gin stand operation, cottonseed, and lint cleaning; machine-picked Acala 1517V, 1967 crop*

Type of ginning air system, treatment No.,[1] and statistical test	Net power required to operate gin stand and feeder[2]	Ginning rate[2,3]	Cottonseed damage in—			Total nonlint contents in ginned lint[2,4]	
			Wagon sample	Feeder sample	Ginned seed sample	Before lint cleaning	After lint cleaning
	Kw.	*Lb./hr./saw*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Conventional:							
1	5.2a	7.4a	9.0	12.0	12.7	5.07a	2.95a
1a	5.3a	7.3a	15.0	13.0	12.7	5.11a	3.48ab
2	6.0ab	8.3ab	10.0	14.0	11.3	5.73ab	3.94abc
2a	5.8a	9.2 bc	12.7	14.3	14.7	6.02abc	4.28abcd
Monoflow:							
3	6.7 bc	9.3 bc	8.3	12.0	11.3	5.83ab	3.86ab
4	7.7 d	10.1 c	11.7	12.3	15.5	6.74abc	4.47abcd
5	7.2 cd	9.4 bc	14.0	14.3	17.0	6.36abc	3.96abc
6	7.2 cd	9.7 c	11.3	14.7	14.3	6.44abc	4.43abcd
7	7.4 cd	10.0 c	11.3	12.3	12.3	7.28abcd	4.66 bcd
7a	7.6 cd	9.9 c	9.7	14.0	13.7	7.94 bcd	5.55 cd
8	8.0 d	10.3 c	12.3	11.0	17.0	9.10 d	5.92 d
8a	8.0 d	10.3 c	10.3	15.7	17.3	8.29 cd	5.55 cd
	Measure of significance[5]						
Statistical significance as determined by analysis of variance:							
Test form 1:[6]							
Treatments	**	**	NS	NS	NS	*	*
Replications	*	NS	NS	NS	NS	**	*
Test form 2:[6]							
Ginning air system	**	**	NS	NS	NS	*	*
Conventional system air conditions	NS	*	NS	NS	NS	NS	NS
Monoflow (1st section) air conditions	NS	NS	NS	NS	NS	NS	NS
Target lint moistures	*	*	NS	NS	NS	NS	NS
Monoflow (1st section) × lint moistures	NS	NS	NS	NS	NS	NS	NS

[1] See table 1 for description of treatments. Each data represents an average of 3 replicate ginning treatments.

[2] Averages followed by the same letter are not significantly different at the 95-percent level as determined by Duncan's Multiple Range Test. Comparison is made across all 12 treatments.

[3] Ginning rate calculated using lint weight corrected to clean, dry values.

[4] Nonlint contents, clean base, as determined by the Shirley Analyzer.

[5] NS = not significant at the 95-percent level; * = significant at the 95-percent level; ** = significant at the 99-percent level.

[6] For description of statistical test forms, see table 14.

The correlation between cleaning efficiency [6] and relative humidity was negative; that is, cleaning efficiency decreased as relative humidity increased.

The correlation between cleaning efficiency and cotton moisture was also negative, but slightly higher. The correlation coefficients between cleaning efficiency and moisture for the individual cleaners were: -0.70 for the first six-cylinder cleaner, -0.39 for the stick and green leaf machine, -0.72 for the second six-cylinder cleaner, -0.52 for the extractor-feeder, and -0.25 for the saw-cylinder lint cleaner. These results indicate that the operation of cylinder cleaners is more adversely affected than that of extractor-type cleaners by higher moisture levels in seed cotton. If the seed cotton cleaners had been fully loaded instead of operating about one-third capacity, the cleaning efficiencies probably would have been lower.

The highest seed cotton cleaning efficiency, 73 percent, was obtained with treatment 1. In this treatment the seed cotton was dried with heated air. The temperature of the air entering the horizontal belt moisture conditioner was 200° F. Both the seed cotton and lint-handling air subsystems were of the conventional type. The lowest seed cotton cleaning efficiency, 65 percent, was obtained with treatments 7 and 8. These two treatments, both of which were conducted with monoflow air systems, were not significantly different in cleaning efficiency. In these treatments the seed cotton was conditioned and handled by an air subsystem with controlled relative-humidity air, which increased the cotton moisture content. Seed cotton cleaning efficiency was significantly different with the conventional and with the monoflow air systems because of the difference in moisture levels associated with the two air systems.

The average lint cleaning efficiency of the lint cleaner was 35 percent, with no significant differences attributable either to variables in the treatments or to type of ginning air system used.

The ginning rate was related to the amount of moisture in the cotton at the time of ginning. The coefficient of correlation between ginning rate and lint moisture was 0.85. The ginning rate varied from a low of 7.3 pounds of clean, dry lint per saw per hour for treatment 1 to a high of 10.3 pounds for treatment 8. The average rate for the conventional system was 8 pounds and for the monoflow system, 9.9 pounds per saw per hour. This difference was highly significant and was caused by the variations in cotton moisture levels and not to the type of air system, except that the use of the monoflow system gave the ginner control over the moisture level in the cotton. An average increase in ginning rate of 0.6 pounds of clean, dry lint per saw per hour occurred for each percentage point increase in lint moisture in the range from 3.1-percent to 7.7-percent lint moisture content.

The net electrical power used to operate the feeder and gin stand combination was proportional to the ginning rate and amounted to 0.01 kilowatt per pound of lint per saw per hour.

Evaluations of Cotton Quality After Ginning

Ginned Lint

Significant differences were found in the Classer's grades (table 9) assigned to lint samples from the various ginning treatments. These differences were related to the decrease in cleaning efficiency resulting from increases in cotton moisture. The highest grade, Middling, was obtained with treatment 1 in which the seed cotton moisture level was the lowest during gin processing. The lowest grade was Strict Low Middling, obtained with treatment 1 in which the seed cotton moisture level was the lowest during gin processing. The lowest grade was Strict Low Middling, obtained with treatments 4, 6, and 8, which were processed with the highest cotton moisture contents. No significant differences were found for Classer's staple length because of variables in the treatments, but there was a difference because of the type of air system used.

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[6] Cleaning efficiency is the ratio of the weight of foreign matter removed from the cotton by a cleaner to the weight of foreign matter contained in the cotton entering the cleaner. Multiplying the ratio by 100 gives the efficiency in percentage.

TABLE 9.—*Effects of ginning treatments on color, classification, and fiber length of ginned lint; machine-picked Acala 1517V, 1967 crop*

Type of ginning air system, treatment No.,[1] and statistical test	Colorimeter, equivalent grade index		Classification		Digital Fibrograph		
	Raw ginned lint	Lint cleaned with Shirley Analyzer	Composite grade [2 3]	Staple length	2.5-pct. span length [3]	50-pct. span length [3]	Uniformity ratio [3]
	Index	*Index*	*Index*	*32d-in.*	*In.*	*In.*	*Pct.*
Conventional:							
1	104.0	104.7	100.6a	38.7	1.213a	0.533a	43.7
1a	104.0	104.3	98.0abc	38.7	1.210a	.540a	44.7abcd
2	102.7	104.7	99.0ab	39.0	1.210a	.530a	44.0ab
2a	104.0	104.7	99.7a	39.7	1.210a	.540a	44.3abc
Monoflow:							
3	102.7	105.0	97.0abcd	39.3	1.237 b	.563 b	46.0 de
4	101.3	104.3	94.0 cd	39.7	1.237 b	.563 b	45.3 bcde
5	102.7	104.7	97.0abcd	39.7	1.243 bc	.570 bc	45.7 cde
6	102.7	104.7	94.0 cd	39.7	1.240 bc	.577 bc	46.3 e
7	102.7	104.7	94.6 bcd	40.0	1.243 bc	.573 bc	45.7 cde
7a	101.3	104.3	95.0 bcd	39.0	1.247 bc	.570 bc	45.3 bcde
8	101.3	104.7	92.7 d	40.0	1.247 bc	.577 bc	46.3 e
8a	101.3	104.3	94.0 cd	40.0	1.257 c	.583 c	46.3 e
	Measure of significance [4]						
Statistical significance as determined by analysis of variance:							
Test form 1:[5]							
Treatments	NS	NS	**	NS	**	**	**
Replications	**	**	NS	NS	**	**	**
Test form 2:[5]							
Ginning air system	NS	NS	**	**	**	**	**
Conventional system air conditions	NS	NS	NS	NS	NS	NS	NS
Monoflow (1st section) air conditions	NS	NS	NS	NS	NS	NS	NS
Target lint moistures	NS	NS	*	NS	NS	NS	NS
Monoflow (1st section) × lint moistures	NS	NS	NS	NS	NS	NS	NS

[1] See table 1 for description of treatments. Each data represents an average of 3 replicate ginning treatments.
[2] 100 = Middling white; 97 = Strict low middling plus, white; 94 = Strict low middling white; 90 = Low middling, white.
[3] Averages followed by the same letter are not significantly different at the 95-percent level as determined by Duncan's Multiple Range Test. Comparison is made across all 12 treatments.
[4] NS = not significant at the 95-percent level; * = significant at the 95-percent level; ** = significant at the 99-percent level.
[5] For description of statistical test forms, see table 14.

The micronaire fineness and maturity reading was 3.5; this reading was not affected by variables in the treatments or by the type of air system used.

Significant differences were found in fiber length as measured by the Digital Fibrograph (table 9) and the Suter-Webb array (table 10). These differences resulted from variables in the treatments and to the type of air system used. The longer lengths were associated with higher moisture levels in the cotton during ginning. The average Suter-Webb array mean length reading was 1.09 inches for the cotton processed at low moisture levels with the conventional system and, for the cotton processed with the monoflow system, 1.13 inches for the 6-percent moisture-level treatments, and 1.14 inches for the 8-percent moisture-level treatments. Similar trends occurred in all other fiber-length measurements.

Pressley strength was not affected by treatments or type of system.

Card Web

Differences in Digital Fibrograph fiber-length measurements were highly significant for treatments and for type of air system. The results were similar to those for the ginned lint in that the longer lengths were associated with the higher cotton moisture levels during ginning. Pressley strength and micronaire fineness and maturity readings were not affected by the ginning treatments. No significant differences in the properties measured (table 11) were found because of use or nonuse of the card crusher rolls.

Combed Drawing Sliver

The only measurement that was significantly different for treatments was the 2.5-percent span length Digital Fibrograph reading. All three Digital Fibrograph measurements were significantly different for the type of air system used and followed the same trend as the ginned lint and card web. Pressley strength and micronaire fineness and maturity readings were not affected by treatments or air systems. None of the measured properties were affected by the use or nonuse of the card crusher rolls.

Evaluations of Yarn Spinning Performan

The total picker and card waste differe (table 12) were highly significant for tre ments and significant for air systems. M waste was removed from the lots with hig moisture content. Differences in comber n were highly significant for both treatme and air systems, but were not significant card crusher rolls. Comber noils decreased w increasing lint moisture.

Neps in the card web were increased the use of card crusher rolls. (The crus rolls flatten neps, making them show up mo but the neps are subsequently remove Among ginning treatments, there was a hig significant difference in card web neps t could not be accounted for.

The break factor differences were hig significant for treatments and for type of system—higher lint-moisture content was sociated with significantly higher bre factor.

The corrected ends down were not affect by ginning treatments or the type of air syst used, but a highly significant difference sulted from use or nonuse of the card crus rolls. The low ends down was obtained by us the card crusher rolls.

Yarn appearance was not significant affected by any of the variables studied.

Differences in three of the Uster sin strand measurements—strength, neps, and regularity coefficient of variation—we highly significant for both treatments a type of air system used. Higher quality w associated with higher moisture in all th measurements. Differences in two Uster mea urements—neps and irregularity coefficient variation—were highly significant for ca crusher rolls, with the higher quality result from the use of rolls.

The correlations between processing mea urements and classer's composite grade ind were determined (table 13). The range of gra index was limited, varying from 92.7 (slight below Strict Low Middling) to 100.6 (Mi dling = 100). There was no significant corre tion between grade and card web neps, ya appearance, corrected ends down per 1,0

TABLE 10.—*Effects of ginning treatments on array fiber length, strength, and fineness and maturity of ginned lint; machine-picked Acala 1517V, 1967 crop*

Type of ginning air system, treatment No.,[1] and statistical test	Suter-Webb array				Pressley strength		Micronaire
	Upper quartile length [2]	Mean length [2]	Coefficient of variation [2]	Fibers shorter than ½ in.[2]	Zero gage	⅛-in. gage	
	In.	*In.*	*Pct.*	*Pct.*	*1,000 p.s.i.*	*G./tex*	*Reading*
Conventional:							
1	1.337a	1.080a	32.0a	9.7a	91.7	26.1	3.4
1a	1.333a	1.090a	31.0a	8.3abc	90.7	26.7	3.5
2	1.337a	1.080a	31.0a	8.7ab	90.7	26.6	3.4
2a	1.347ab	1.097a	30.7a	8.7ab	90.3	26.3	3.5
Monoflow:							
3	1.357 bcde	1.133 bcd	27.7 b	6.7 de	90.3	26.7	3.4
4	1.367 de	1.140 bcd	27.3 b	5.7 e	90.7	26.7	3.5
5	1.353 bcd	1.127 bc	28.7 b	7.3 bcd	91.3	26.7	3.4
6	1.363 cde	1.143 cd	27.7 b	6.7 de	91.3	27.4	3.5
7	1.350 bc	1.120 b	28.7 b	7.3 bcd	91.3	26.1	3.5
7a	1.357 bcde	1.130 bcd	28.3 b	7.0 cde	91.7	26.5	3.5
8	1.367 de	1.150 d	27.0 b	6.0 de	92.0	27.2	3.5
8a	1.370 e	1.147 cd	27.7 b	6.3 de	91.7	27.4	3.6
	Measure of significance [3]						
Statistical significance as determined by analysis of variance:							
Test form 1:[4]							
Treatments	**	**	**	**	NS	NS	NS
Replications	**	**	*	NS	**	NS	NS
Test form 2:[4]							
Ginning air system	**	**	**	**	NS	NS	NS
Conventional system air conditions	NS	NS	NS	NS	NS	NS	NS
Monoflow (1st section) air conditions	NS	NS	NS	NS	NS	NS	NS
Target lint moistures	**	**	*	*	NS	NS	NS
Monoflow (1st section) × lint moistures	NS	NS	NS	NS	NS	NS	NS

[1] See table 1 for description of treatments. Each data represents an average of 3 replicate ginning treatments.

[2] Averages followed by the same letter are not significantly different at the 95-percent level as determined by Duncan's Multiple Range Test. Comparison is made across all 12 treatments.

[3] NS = not significant at the 95-percent level; * = significant at the 95-percent level; ** = significant at the 99-percent level.

[4] For description of statistical test forms, see table 14.

TABLE 11.—*Effects of ginning treatments on fiber length, strength, and fineness and maturity of cotton during processing; machine-picked Acala 1517V, 1967 crop*

Type of ginning air system, treatment No.,[1] and statistical test	Card web: Digital Fibrograph: 2.5-pct. span length[2]	Card web: Digital Fibrograph: 50-pct. span length[2]	Card web: Digital Fibrograph: Uniformity ratio[2]	Card web: Pressley strength ⅛-inch gage	Card web: Micronaire	Combed drawing sliver: Digital Fibrograph: 2.5-pct. span length[2]	Combed drawing sliver: Digital Fibrograph: 50-pct. span length	Combed drawing sliver: Digital Fibrograph: Uniformity ratio	Combed drawing sliver: Pressley strength ⅛-inch gage	Combed drawing sliver: Micronaire
	In.	*In.*	*Pct.*	*G./tex*	*Reading*	*In.*	*In.*	*Pct.*	*G./tex*	*Reading*
Conventional:										
1	1.183a	0.510abc	43.0ab	24.8	3.5	1.343a	0.707	52.3	25.1	3.6
1a	1.167 b	.507ab	43.0ab	24.5	3.5	1.343a	.717	53.7	25.3	3.6
2	1.177ab	.503a	42.3a	25.6	3.5	1.353ab	.713	53.0	25.8	3.6
2a	1.187ab	.513abc	43.3abc	25.7	3.5	1.350ab	.710	52.7	25.1	3.6
Monoflow:										
3	1.203 cd	.533 bcde	44.0abc	25.6	3.5	1.350ab	.717	53.0	25.9	3.6
4	1.217 de	.543 de	45.0 cd	25.7	3.5	1.350ab	.727	54.0	26.0	3.6
5	1.210 de	.533 bcde	44.0abc	25.7	3.5	1.363ab	.723	53.3	25.9	3.6
6	1.217 de	.543 de	44.7 bcd	25.1	3.5	1.373 b	.740	53.7	25.8	3.7
7	1.203 cde	.530abcd	44.0abc	25.7	3.5	1.353ab	.733	54.3	25.9	3.6
7a	1.200 cd	.537 cde	44.7 bcd	25.4	3.5	1.360ab	.737	54.0	26.0	3.6
8	1.220 e	.550 de	45.0 cd	26.0	3.5	1.373 b	.740	54.0	26.1	3.5
8a	1.220 e	.560 e	46.0 d	25.6	3.5	1.373 b	.743	54.7	25.9	3.6
	Measure of significance[3]									
Statistical significance as determined by analysis of variance:										
Test form 1:[4]										
Treatments	**	**	**	NS	NS	*	NS	NS	NS	NS
Replications	**	*	*	*	*	**	**	**	NS	NS

Test form 2:[4]										
Ginning air system	**	**	**	NS	NS	*	*	*	NS	NS
Conventional system air conditions	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Monoflow (1st section) air conditions	NS	NS	NS	NS	NS	*	NS	NS	NS	NS
Target lint moistures	*	NS	NS	NS	NS	NS	NS	NS	NS	NS
Monoflow (1st section) × lint moistures	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Test form 3:[4]										
Card crusher rolls and no crusher rolls	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[1] See table 1 for description of ginning treatments. Each data represents an average of 3 replicate ginning treatments.

[2] Averages followed by the same letter are not significantly different at the 95–percent level as determined by Duncan's Multiple Range Test. Comparison is made across all 12 treatments.

[3] NS = not significant at the 95–percent level; * = significant at the 95–percent level; ** = significant at the 99–percent level.

[4] For description of statistical test forms, see table 14.

TABLE 12.—*Effects of ginning treatments on processing test factors; machine-picked Acala 1517V, 1967 crop*

Type of ginning air system, treatment No.,[1] and statistical test	Processing test factors						Average for Uster single strand evaluation			
	Picker and card waste[2]	Comber-noils[2]	Neps per 100 square inches of card web[2]	Break factor[2]	Yarn appear-ance	Corrected ends down (EDMSH)	Strength[2]	Elon-gation	Neps per 1,000 yards[2]	Irregu-larity, coefficient of vari-ation[2]
	Pct.	*Pct.*	*No.*	*Units*	*Index*	*No.*	*G.*	*Pct.*	*No.*	*Pct.*
Conventional:										
1	5.30a	16.1a	16.3a	2656a	92.7	14	167a	5.7	265 c	18.8 b
1a	5.30a	16.4a	13.7 bcd	2667a	91.7	16	165a	5.7	456 g	19.1a
2	5.55ab	15.2 b	15.3ab	2711a	97.0	13	167a	5.7	240 bc	18.6 bc
2a	5.48ab	15.1 b	11.7 e	2710a	86.0	15	168ab	5.7	439 fg	18.8ab
Monoflow:										
3	5.47ab	13.5 cd	16.0a	2792 b	98.7	16	174 c	5.7	191ab	18.3 cd
4	6.51 bc	13.6 c	15.0abc	2798 bc	100.3	10	175 c	5.6	194ab	18.2 cd
5	5.65ab	13.9 c	16.3a	2771 b	98.0	10	173 bc	5.7	190ab	18.2 cd
6	5.96ab	13.4 cd	15.3ab	2808 bc	96.7	16	175 c	5.7	193ab	18.1 d
7	6.44 bc	13.1 de	15.7a	2772 b	100.0	13	175 c	5.7	176a	18.0 d
7a	6.52 bc	13.3 cd	13.0 de	2793 b	95.3	20	176 c	5.8	344 d	18.4 cd
8	7.20 c	12.9 ef	16.3a	2831 bc	96.0	13	173 bc	5.5	209abc	18.1 d
8a	7.12 c	12.5 ef	13.3 cde	2854 c	95.0	21	176 c	5.6	400 efg	18.4 cd
	Measure of significance[3]									
Statistical significance as determined by analysis of variance:										
Test form 1:[4]										
Treatments	**	**	**	**	NS	NS	**	NS	**	**
Replications	**	*	*	**	NS	NS	**	**	**	**

Test form 2:[4]										
Ginning air system	*	**	NS	**	NS	NS	**	NS	**	**
Conventional system air conditions	NS	**	NS	NS	NS	NS	NS	NS	NS	NS
Monoflow (1st section) air conditions	*	**	NS	NS	NS	NS	NS	NS	NS	NS
Target lint moistures	*	NS	NS	NS	NS	NS	NS	*	NS	NS
Monoflow (1st section) × lint moistures	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Test form 3:[4]										
Card crusher rolls and no crusher rolls	NS	NS	**	NS	NS	**	NS	NS	**	**

[1] See table 1 for description of treatments. Each data represents an average of 3 replicate ginning treatments.

[2] Averages followed by the same letter are not significantly different at the 95-percent level as determined by Duncan's Multiple Range Test. Comparison is made across all 12 treatments.

[3] NS = not significant at the 95-percent level; * = significant at the 95-percent level; ** = significant at the 99-percent level.

[4] For description of statistical test forms, see table 14.

TABLE 13.—*Summary of linear regression analysis*

Measurement or property analyzed, and variables (X and Y)[1]	Regression coefficient	Correlation of X and Y: Correlation coefficient (r)	Correlation of X and Y: Significance level of r^2
			Pct.
Ginning operations measurements when:			
X = relative humidity of air (pct.) near suction telescope and Y = moisture regain (pct.) in wagon seed cotton.	—	−0.294	NS
X = relative humidity of air (pct.) in separator No. 1 for unloading and Y = moisture regain (pct.) in wagon seed cotton.	—	−.191	NS
X = relative humidity of air (pct.) in seed cotton separator No. 2 and Y =			
Trash moisture regain (pct.) in 6–cylinder cleaner No. 2	0.0911	.916	99
Cleaning efficiency (pct.) in 6–cylinder cleaner No. 2	−.0724	−.620	99
Trash moisture regain (pct.) in stick and green leaf machine	.0857	.818	99
Cleaning efficiency (pct.) in stick and green leaf machine	[3]	−.248	NS
X = relative humidity of exhaust air (pct.) from 6–cylinder cleaner No. 2 and Y =			
Seed cotton moisture regain (pct.) in 6–cylinder cleaner No. 2	.0406	.756	99
Trash moisture regain (pct.) in 6–cylinder cleaner No. 2	.0674	.612	99
Cleaning efficiency (pct.) in 6–cylinder cleaner No. 2	−.1400	−.684	99
X = relative humidity of air (pct.) entering feeder and Y =			
Seed cotton moisture regain (pct.) in feeder	.0358	.836	99
Trash moisture regain (pct.) in feeder	.0699	.782	99
Cleaning efficiency (pct.) of feeder	−.0705	−.355	95
X = relative humidity of exhaust air (pct.) from lint cleaner condenser and Y =			
Moisture regain (pct.) in ginned lint entering lint cleaner	.1029	.947	99
Trash moisture regain (pct.) in lint cleaner	.0766	.802	99
Cleaning efficiency (pct.) of lint cleaner	[3]	−.237	NS
Moisture regain in ginned lint (pct.) on lint slide	.1032	.915	99
X = seed cotton moisture regain (pct.) in 6–cylinder cleaner No. 2 and Y =			
Cleaning efficiency (pct.) of 6–cylinder cleaner No. 1	−1.8237	−.702	99
Cleaning efficiency (pct.) of stick and green leaf machine	−1.0810	−.392	95
Cleaning efficiency (pct.) of 6–cylinder cleaner No. 2	−2.7512	−.722	99
X = seed cotton moisture regain (pct.) in feeder and Y = cleaning efficiency (pct.) of feeder.	−2.402	−.519	95
X = moisture regain (pct.) in ginned lint entering lint cleaner and Y =			
Cleaning efficiency (pct.) in lint cleaner	[3]	−.252	NS
Ginning rate in pounds of clean dry lint (per saw per hour)	0.6025	0.847	99
X = ginning rate in pounds of clean dry lint (per saw per hour) and Y = electric power (kw.) required to drive feeder and gin stand.	.8084	.898	99

Measurements of ginned-lint properties when:			
X = moisture regain (pct.) in ginned lint on lint slide and			
Y =			
Composite grade (index) classification	−1.3677	−.703	99
Staple length (1/32d in.) classification	.2561	.556	99
Upper quartile length (in.), Suter-Webb array	.0072	.796	99
Mean length (in.), Suter-Webb array	.0147	.875	99
Coefficient of variation (pct.), Suter-Webb array	−.9544	−.855	99
Fibers shorter than ½-inch (pct.), Suter-Webb array	−.6526	−.796	99
2.5-percent span length (in.), Digital Fibrograph	.0091	.774	99
50-percent span length (in.), Digital Fibrograph	.0101	.793	99
50/2.5 uniformity ratio, Digital Fibrograph	.4778	.702	99
Fiber strength, ⅛-inch gage (g./tex), Pressley strength tester	.1809	.392	95
Fineness and maturity, micronaire reading	.0200	.404	95
Measurements of card-web properties when:			
X = moisture regain (pct.) in ginned lint on lint slide and			
Y =			
2.5-percent span length (in.), Digital Fibrograph	.0098	.804	99
50-percent span length (in.), Digital Fibrograph	.0096	.711	99
50/2.5 uniformity ratio, Digital Fibrograph	.5115	.627	99
Fiber strength, ⅛-inch gage (g./tex), Pressley strength tester	.1813	.408	95
Fineness and maturity, micronaire reading	([3])	.133	NS
Measurements of drawing-sliver properties when:			
X = moisture regain (pct.) in ginned lint on lint slide and			
Y =			
2.5-percent span length (in.) Digital Fibrograph	.0055	.504	99
50-percent span length (in.), Digital Fibrograph	.0063	.429	99
50/2.5 uniformity ratio, Digital Fibrograph	.2690	.352	95
Fiber strength, ⅛-inch gage (g./tex), Pressley strength tester	.1607	.476	99
Fineness and maturity, micronaire reading	([3])	.110	NS
Processing measurements when:			*Pct.*
X = moisture regain (pct.) in ginned lint on lint slide and			
Y =			
Total picker and card waste (pct.)	.3670	.647	99
Comber noils (pct.)	−.7263	−.924	99
Card web neps (No./100 sq. in. of web)	([3])	.099	NS
Break factor (units)	33.90	.854	99
Yarn appearance (index)	([3])	.299	NS
Corrected ends down (No./1,000 spindle hr.)	([3])	.119	NS
Strength (g.), Uster single strand evaluation	2.165	.693	99
Elongation (pct.), Uster single strand evaluation	−.0297	−.410	95
Neps (No./1,000 yd.), Uster single strand evaluation	([3])	−.316	NS
Irregularity coefficient of variation (pct.), Uster single strand evaluation	−.1522	−.676	99

See footnotes at end of table.

TABLE 13.—*Summary of linear regression analysis*—Continued

Measurement or properties analyzed, and variables (X and Y)[1]	Regression coefficient	Correlation of X and Y	
		Correlation coefficient (r)	Significance level of r[2]
			Pct.
Processing measurements when—Continued			
X = composite grade (index) classification and			
Y =			
Total picker and card waste (pct.)	-0.2054	-0.710	99
Comber noils (pct.)	.2469	.616	99
Card web neps (No./100 sq. in. of web)	([3])	-.201	NS
Break factor (units)	-12.92	-.603	99
Yarn appearance (index)	([3])	-.130	NS
Corrected ends down (No./1,000 spindle hr.)	([3])	-.081	NS
Strength (g.), Uster single strand evaluation	-.7557	-.474	99
Elongation (pct.), Uster single strand evaluation	.0166	.448	99
Neps (No./1,000 yd.), Uster single strand evaluation	([3])	.173	NS
Irregularity coefficient of variation (pct.), Uster single strand evaluation	.0512	.446	99

[1] X = independent variable; Y = dependent variable regressed on X. Each calculation made using 36 X,Y data pairs.
[2] NS = indicates a significance level below 95 percent.
[3] Value not given because r is not statistically significant at the 95-percent level.

spindle hours and Uster single strand neps per 1,000 yards. Low but highly significant correlations were found between grade index and Uster single strand strength, elongation, and irregularity coefficient of variation. The only correlation coefficients of grade index against processing measurements that were more than 0.50 were: total picker and card waste -0.71, indicating more waste with lower grade index; comber noils 0.62, indicating more noils with increasing grade index; and break factor -0.60, indicating decreasing break factor with increasing grade index.

SUMMARY AND CONCLUSIONS

Control of cotton moisture content throughout the ginning process is desirable and can be achieved by controlling the temperature and humidity of all air used to handle the cotton. However, the cost of conditioning the many sequential streams of air used in a conventional ginnery is prohibitive. The monoflow ginning air system consists of only two airstreams, one for handling seed cotton and one for handling lint, formed by connecting the many sequential streams in series. The cotton moisture content is controlled by controlling the relative humidity of these two airstreams.

An experiment was made to evaluate the effects on ginning, cotton quality, and spinning of: (1) The monoflow as compared with a conventional air system and (2) the monoflow system's control of cotton moisture content to two different levels during ginning. The effect of using or not using card crusher rolls on cottons ginned with the two air systems was also included in the study.

The seed cotton handling air was conditioned by a manually controlled commercial unit. The source of the lint handling and conditioning air was the conditioned gin-room air.

Eight primary ginning treatments were used, two with the conventional and six with the monoflow air systems. Four of the eight treatments were repeated. Each test was replicated three times. Thus, a total of 36 ginning lots were used. The four duplicate treatments (two ginned with the conventional and two ginned with the monoflow air systems) were not subjected to card crusher rolls during mill processing. Card crusher rolls were used for the eight primary treatments.

No adverse effects of ginning operations on lint quality and spinning efficiency were apparent when the monoflow system was compared with the conventional ginning air system.

The monoflow system operated satisfactorily and was used to control the cotton moisture to the two levels selected for the ginning treatments by manually controlling the system's air relative humidity.

From the standpoint of lint quality and spinning performance, the monoflow system provided an effective means of controlling air temperature and humidity during ginning. However, no significant differences between the monoflow treatments were found, other than those attributable to differences in lint moisture levels. This finding indicates that each monoflow configuration is equally effective, provided the desired moisture level is maintained.

The studies of the use or nonuse of card crusher rolls were independent of the studies of the type of ginning air system used. However, the crusher-roll studies indicated that use of the rolls reduced the number of spinning ends down, neps in the yarn, and yarn irregularities.

All of the significant changes in measured variables were attributable, either directly or indirectly, to differences in moisture content, except for changes in the effects of the card crusher rolls. The lint moisture content for the eight primary and four duplicate ginning treatments ranged from 3 to 7.6 percent. When the moisture of the cotton increased, the following changes occurred:

- Seed cotton cleaning decreased.
- Classers' grade index decreased.
- Ginning rate increased.
- All fiber length measurements increased, but the Classers' staple length and the combed drawing sliver Digital Fibrograph 50-percent span length were not increased significantly.

- The percentage of short fiber decreased.
- Picker and card waste increased.
- Comber noils decreased.
- Yarn break factor increased.
- Yarn strength increased.
- Yarn neps and irregularities decreased.

Within the limited range of Classers' grade index, 92.7 to 100.6, each spinning quality either was independent of grade or decreased with increasing grade.

APPENDIX

Sampling

The following samples were taken during ginning:

Sampling location	*Number of samples per ginning lot and factor measured*
Wagon	3 samples, for seed cotton moisture determination.
6-cylinder cleaner No. 2	3 samples, for seed cotton moisture determination.
Feeder apron	6 samples, for seed cotton moisture determination.
Seed conveyor	3 samples, for cottonseed moisture and damage determination.
Lint cleaner condenser outlet, before lint cleaning	3 samples, for lint moisture determination.
	2 samples, for nonlint determination.
Lint slide to press box	3 samples, for lint moisture determination.
	2 samples, for nonlint determination.

One sample of foreign matter from each of nine machines (cleaners and air filters) was taken from each lot for moisture determination.

Statistical Procedure

Three forms of analysis of variance were used in analyzing the data. These are given in table 14. Linear regression analyses were made on many of the measurements, particularly of the moisture regains of seed cotton, lint, and trash against the relative humidities of appropriate air streams. Data from all 36 test lots of ginned lint were used, as these data included a wider range of values for the measurements.

TABLE 14.—*Forms of analysis of variance used to analyze ginning-treatment data*

Test form No. and statistical use, and source of variation	Degrees of freedom
No. 1, used for analyzing all 12 treatments:[1]	
Treatments	11
Replications	2
Error	22
Total	35
No. 2, used for analyzing treatments 1 through 8:	
Treatments—	
Conventional system and monoflow system	1
Conventional system, heated air and ambient air	1
Monoflow system, 1st section, air conditions	2
Lint moisture contents (6 and 8 percent) at lint slide	1
Monoflow system, 1st section, air conditions and lint moisture at lint slide	2
Subtotal	7
Replications	2
Error	14
Total	23
No. 3, used for analyzing treatments 1, 1a, 2, 2a, 7, 7a, 8, and 8a:	
Treatments—	
Card crusher rolls and no crusher rolls	1
Conventional system and monoflow system	1
Processing treatment with card crusher rolls and type of gin air system	1
Conventional, heated air and ambient air	1
Conventional system and processing treatment with card crusher rolls	1
Lint moisture contents (6 and 8 percent) at lint slide	1
Lint moisture contents at lint slide and processing treatment with card crusher rolls	1
Subtotal	7
Replications	2
Error	14
Total	23

[1] See table 1 for description of treatments.

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